probable errors in the use of the method for studying the rate of photosynthesis as affected by carbon dioxide concentration.

Part III deals with the effect of short periods of darkening of varying length upon the time needed for resumption of bubbling after reillumination. The longer the darkening, within certain limits, the longer the time required for bubble resumption. This is explained by diffusion (during darkening, as determined by the gas gradients) contracting the gas volume in the intracellular spaces and thereby drawing water into these spaces. The longer the period of darkening the greater the contraction. On the basis of these results KNIEP develops in part IV a method for determining the minimum light intensity necessary to produce oxygen elimination into the intracellular spaces, or to give an excess of photosynthetic gas exchange over the respiratory exchange. It is 2.8 candle meters. This paper deals mainly with methods that are to be used later in answering various questions in photosynthesis.—WILLIAM CROCKER.

**Life histories in Laminariaceae.**—In his recent investigation of *Saccorhiza bulbosa*, SAUVAGEAU[4] found that germinating zoospores behave quite at variance with results reported by other workers. Instead of a protonema, as found by WILLIAMS,[5] DREW,[6] and KILLIAN,[7] he found that the erect plant is developed directly, and also[8] that *Saccorhiza* shows heterogamy and distinct alternation of generations.

After swimming about for a time, the zoospore comes to rest, rounds out, and develops a membrane, becoming an "embryospore." Subsequent behavior determines whether the embryospore is to be a male or female gametophyte. In the latter case the embryospore doubles its diameter, multiplies its chromatophores without division of the nucleus, and in a short time a tube puts out, of about the same diameter as the embryospore, though its length may greatly exceed the diameter; into the tip of this tube the entire contents of the embryospore migrate. Finally the membrane is ruptured and there escapes a single naked uninucleate mass, slightly elongated in form, which remains attached to the mouth of the empty embryospore tube. This naked mass, which is the

[4] SAUVAGEAU, C., Sur le développement et la biologie d'une Laminaire (*Saccorhiza bulbosa*). Compt. Rend. Acad. Sci. **160**:445–448. 1915; **161**:740–742. 1915.

[5] WILLIAMS, J. L., Germination of the zoospore in the Laminariaceae. Rept. British Ass. Adv. Sci. (Bradford) 1900.

———, The zoospores of the Laminariaceae and their germination. Rept. British Ass. Adv. Sci. (Dundee) 1912.

[6] DREW, G. H., The reproduction and early development of *Laminaria digitata* and *L. saccharina*. Ann. Botany **24**:177–190. 1910.

[7] KILLIAN, K., Beiträge zur Kenntnis der Laminarien. Zeitschr. Bot. **3**:433–494. 1911.

[8] SAUVAGEAU, C., Sur la sexualité hétérogamique d'une Laminaire (*Saccorhiza bulbosa*). Compt. Rend. Acad. Sci. **161**:796–799. 1915.

egg, soon develops a wall about itself, separating it from the abandoned tube. Sometimes the embryospore nucleus divides, giving two cells; then the anterior cell behaves like an ordinary embryospore; or if a monosiphonous filament of several uninucleate cells is formed, the anterior cell again functions. Only in weak and poorly developed cultures did SAUVAGEAU observe erect branches from the embryospore; in these cases each erect branch behaves in the manner described.

If the embryospore is to develop a male gametophyte, its diameter is increased little or none, elongation is very rapid, but the entire structure remains very minute. The antheridia develop as rounded colorless buds, each enclosing a single sperm, which after its escape is seen to be motile, colorless, and laterally biciliate.

Fertilization was not observed, but SAUVAGEAU assumes that it occurs and that from the fertilized egg the plantlet or sporophyte develops immediately. His account from this stage on differs in few essentials from the accounts of other workers, the stipe and blade being differentiated at a very early stage.

It is to be regretted that at the critical stages details are not more clearly given. However, it is evident from this account, as also from that of DREW, that there are certain phases in the life history of the Laminariaceae which are in need of critical investigation, especially from a cytological point of view. DREW concluded that as a result of conjugation of isogamous gametes a filament (the sporophyte) developed which in turn gave rise to the plantlet (the gametophyte). SAUVAGEAU concludes that the gametophyte comes very early in the cycle; in fact, it is practically a walled zoospore, and the plantlet which is produced as the result of fertilization of the egg is the sporophyte. It would seem that a careful investigation might clear up the haziness which still remains about these phases in the life history.—MABEL L. ROE.

**Tannins.**—MOELLER[9] has noted peptization phenomena in tannin solutions, and believes that they form the basis of the process of tanning. A tannin extract contains two sorts of substances: (1) a tannin that is soluble in water, and (2) an accompanying substance, a gel, which is insoluble in water. With pyrogallol tannins this accompanying substance is called ellagic acid, and with pyrocatechin tannins it is called phlobaphene. The ellagic acid and phlobaphene, while insoluble in water, are soluble in the tannin solution; that is, the tannin peptizes the ellagic acid gel and the phlobaphene gel, the tannin being called the peptizator and the gel the peptized substance. In the process of tanning the hide adsorbs the peptizator and the gel coagulates out, surrounds the fibers of the hide, and leather is formed. He says a true solution cannot tan a hide, but only a peptized solution, and that all tanning solutions

[9] MOELLER, W., Die Peptisationserscheinungen in Gerbstofflösungen. Kolloid. Zeitsch. **16**:69–76. 1915.